more probability of its being abandoned, and the old doctrine of the fixity of species revived, than that we should revert to the old astronomical theories which placed the earth in the centre of the universe, and limited the date of its creation to six ordinary days.

The question of the fixity or the transmutation of species is a purely scientific one, only to be discussed and decided on scientific grounds. To the naturalist, it is clearly one of extreme importance, as it gives him for the first time a key to the interpretation of the phenomena with which he has to deal. It may seem to many that a question like this is entirely beside the business of a Church Congress, as it is one with which only those expert in the ways of scientific investigation, and deeply imbued with knowledge of scientific facts, could be called upon to deal. This would certainly have been my view, if it had not been that some who, from their capacities and education, should have been onlookers in such a controversy, awaiting the issues of the conflict while the lists are being fought out by the trained knights, have rushed into the fray, and by their unskilful interposition have only confused the issues, casting about dust instead of light. In the hope of clearing away some of this dust the present discussion has been decided upon.

It is self-evident that a solid advance of any branch of knowledge must, in some way or other, and to a greater or less degree, influence many others, even those not directly connected with it, and therefore the rapid simultaneous strides of so many branches of knowledge as may be embraced under the term of "Recent Advances in Natural Science," will be very likely to have some bearing upon theological beliefs. Whether in the direction of expanding, improving, purifying, elevating, or in the direction of contracting, hardening, or destroying, depends not upon those engaged in contributing to the advance of science, but upon those whose special duty it is to show the bearing of these advances upon hitherto received theological dogmas. The scientific questions themselves may well be left to experts. If the new doctrines are not true, there are plenty of keen critics among men of science ready to sift the sound from the unsound. Error in scientific subjects has its day, but it is certain not long to survive the ordeal, yearly increasing in severity, to which it is subjected by those devoted to its cultivation. On the other hand, the advances of truth, though they may be retarded, will never be stopped by the opposition of those who are incompetent by the nature of their education to deal with the evidence on which it rests. There is no position so fraught with danger to religion as that which binds it up essentially with this or that scientific doctrine, with which it must either stand or fall. The history of the reception of the greatest discoveries in astronomy and geology, the passionate clinging to the exploded pseudo-scientific views on those subjects supposed to be bound up with religious faith, the fierce denunciations of the advocates of the then new, but now universally accepted, ideas, are well-worn subjects, and would not be alluded to but for the repetition, almost literal repetion in some cases, of that reception which has been accorded to the new views of biology.

Ought not the history of those discoveries and the controversies to which they gave rise to be both a warning and an encouragement? Those who hoped and those who feared that faith would be destroyed by them have been equally mistaken; and is not probable that the same result will follow the great biological discoveries and controversies of the present day?

In stating thus briefly what is the issue of these discoveries, as generally understood and accepted by men of science, I have done all that I promised, and must leave in far more competent hands the part of the subject especially appropriate for discussion at this meeting. I may, however, perhaps be allowed to put a few plain and simple considerations before you, which may have some bearing upon the subject, and which have no pretensions to novelty, though, being often lost sight of, their repetition may do no harm.

I said at the commencement of this paper that it has long been admitted by all educated persons, whatever their religious faith may be, that that very universal but still most wonderful process, the commencement and gradual development of a new individual of whatever living form, whether plant, animal, or man, takes place according to definite and regularly acting laws, without miraculous interposition. Further than this, I believe that every one will admit that the production of the various races or breeds of domestic animals is brought about by similar means. We do not think it necessary to call in any special intervention of creative power to produce a short-horned race of cattle, or to account for the difference between a bulldog and a greyhound, a Dorking and a Cochin China fowl. The gradual modifications by which these races were produced, having taken place under our own eyes as it were, we are satisfied that they are the consequence of what we call natural laws, modified and directed in these particular cases by man's agency. We have even gone further, having long admitted, without the slightest fear of producing a collision with religious faith, that variation has taken place among animals in a wild state, producing local races of more or less stable and permanent character, and brought about by the influence of food, climate, and other surrounding circumstances.

The evidences of the Divine government of the world, and of the Christian faith, have been sufficient for us, notwithstanding our knowledge that the individual was created according to law, and that the race or variety was also created according to law. In what way then can they be affected by the knowledge that the somewhat greater modifications, which we call species, were also created according to law? The difficulties, which to some minds seem insuperable, remain exactly as they were; the proofs, which to others are so convincing, are entirely unaffected by this widening of scientific knowledge.

Even to what is to many the supreme difficulty of all, the origin of man, the same considerations are applicable. Believe everything you will about man in his highest intellectual and moral development, about the nature, origin, existence, and destiny of the human soul—you have long been able to reconcile all this with the knowledge of his individual material origin according to law, in no whit different in principle from that of the beasts of the field, passing through all the phases they go through, and existing long before possessing, except potentially, any of the special attributes of humanity. At what exact period and by what means the great transformation takes place no one can tell. If the most Godlike of men have passed through the stages which physiologists recognise in human development without prejudice to the noblest, highest, most divine part of their nature, why should not the race of mankind, as a whole, have had a similar origin, followed by similar progress and development, equally without prejudice to its present condition and future destiny? Can it be of real consequence at the present time, either to our faith or our practice, whether the first man had such an extremely lowly beginning as the dust of the earth, in the literal sense of the words, or whether he was formed through the intervention of various progressive stages of animal life?

The reign of order and law in the government of the world has been so far admitted that all these questions have really become questions of a little more or a little less order and law. Science may well be left to work out the details as it may. It has thrown some light, little enough at present, but ever increasing, and for which we should all be thankful, upon the processes or methods by which the world in which we dwell has been brought into its present condition. The wonder and mystery of creation remains as wonderful and mysterious as before. Of the origin of the whole, science tells us nothing. It is still as impossible as ever to conceive that such a world, governed by laws, the operations of which have led to such mighty results, and are attended by such future promise, could have originated without the intervention of some power external to itself. If the succession of small miracles, formerly supposed to regulate the operations of nature, no longer satisfies us, have we not substituted for them one of immeasurable greatness and grandeur?

A GREEN SUN IN INDIA

We have received the following communications on this phenomenon. At the same time we may refer to a passage in one of Mr. Norman Lockyer's papers on "Physical Science for Artists," in which he speaks of the marked effects of aqueous vapour in the atmosphere on the character of the sun's light. He states that he asked Dr. Schuster to test his theory while in India. "Theory," he states, "had led me to expect that with the enormous thickness of air available there, absorption at the red end of the spectrum by aqueous vapour would be seen as well as the absorption at the blue, which is so common with us. Seeing the sun a vivid green through the steam of the little paddle-boat on Windermere first led me to inquire into the possibility of aqueous vapour following the same law as that which I think we may now accept in the cases of the vapours of metals. As in these experiments with vapours absorption of the red end alone was seen, as well as absorption at the blue end alone, the assumption that these two absorptions existed in aqueous vapour at once accounted for the green sun." In the sequel it will be found that Dr. Schuster's observations quite confirmed Mr. Lockyer's theory.

BY my friend Major A. T. Fraser, R.E., I have just been favoured with a copy, which I now inclose to you, of a Madras paper, dated September 12, giving not only the frightened comments of a dozen different, unpractised observers on the *green* sun, seen morning and evening over the south-east of India during the two or three previous days, but also the spectroscopic explanation thereof by Rev. Prof. Michie Smith, which is so good that you may perhaps think well to introduce it into your columns.

The case too is further worth notice here, as an example of the occasional powers of the rain-band spectroscope over and above the wet and dry bulb thermometers, to tell us what is in the upper air now and will visit us soon below. For on those days when the greenness of the sun was undoubtedly due to being seen through strata of atmosphere inordinately charged with watery vapour (much as I set forth in vol. xiv. of "Edinburgh Astronomical Observations," was the case so eminently at Palermo in 1872), the air in contact with the dwellings of man was dry.

It has been so too for a considerable time, as testified by Mr. Pogson at the Madras Observatory, both by his daily hygrometric observations, and by his record of rainfall for the year being behind the usual quantity by about a third of the whole. From this circumstance apparently, "some of the learned old men," but knowing nothing of spectroscopy, in that locality, needlessly afflicted themselves and their neighbours also, by proclaiming that the *green* sun, in place of being a sign of good times coming, "was a bad omen for the country, and would bring a famine this year."

But though there was still a drought at Madras, the same paper involuntarily reports that abundant rain had begun to fall further away to the south and west, or to the extent, at Travancore, of 5·91 inches, and at Malabar of 10·14 inches, in one week.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, October 9

WE have just been having the curious phenomenon of a greenish colour in the light of the sun. Letters to the Madras papers show that the same thing has been noticed in many other parts of Southern India. It is new to me, and to every one else who has seen it, so far as I have heard. The native astronomers say that there is a planet wholly absorbed in the sun, and that if it leaves the sun a green light will appear. Or, according to others, if Venus comes in contact with the sun, which, according to their calendars, is the case now, a green light will be seen. Both agree, however, in portending evil to the inhabitants of this planet; consequently there has been no little curiosity and speculation awakened by this singular appearance, and more or less of uneasiness in the minds of the ignorant and superstitious natives. As I am principal of the High School in this place, and teacher in a small way of science, they apply to me for the scientific solution of the mystery; but, farther than a mere conjecture, I have to confess myself quite as much in the dark as the rest.

Doubtless others of your correspondents have noticed the same thing, and my description may be superfluous; yet I venture to give it, as it may at least corroborate the statements of other observers.

My attention was first called to the matter by one of my teachers about four o'clock on the afternoon of September 10, but I learn that the same thing was noticed elsewhere the day before. At the time of which I speak I noticed that the light from the sun shining into the room through an open western door threw a curious pale blue colour on the floor. I also noticed that it had something of the effect upon colours that is commonly seen in coloured lights. On looking out I saw that the sun, which was somewhat dimmed by a haze, had a decidedly greenish-blue tinge. The same thing was observed on the 11th and 12th, both morning and evening; but my observations were confined to the evenings. About four o'clock (at least I did not notice it earlier) an indistinct bluish tinge appeared in the light. This gradually passed into a greenish colour, and this in turn became tinged with yellow as the sun approached the horizon. As the sun sank, bands of smoky haze drifted across its disk. After the sun was down, bright yellow, orange, and red appeared in the west, a very deep red remaining for more than an hour after sunset; whereas under ordinary conditions all traces of colour leave the sky in this latitude within half an hour after the sun disappears. At night the moon, just past the first quarter was surrounded by a pale greenish halo some thirty degrees in breadth.

After sunset I observed a peculiar appearance in the haze which covered the sky. It was not of sufficient density to be at all visible, except where it reflected the direct rays of the sun. There it had a singular mottled appearance, with a smoky look along the borders of the denser portions, suggesting clouds of smoke or dust in the upper regions of the atmosphere.

Of course the question which every one is asking now is, What caused the green light? very few, so far as I have learned, having noticed anything else. The succession of colours which I have mentioned, occurring exactly in the order of the solar spectrum, would seem to indicate beyond a doubt the presence of some highly refracting substance in the atmosphere which resolved the sun's rays into primary colours and gave us in succession, according to the angle of the sun to the horizon, blue, green, yellow, orange, and red, the two latter only appearing as reflected from the under surface of the haze. On the evening of the 13th the sun appeared to be perfectly clear, but after it was below the horizon the western sky was seen to be covered with a smoky haze of a singular appearance, which became brilliantly illuminated with yellow, orange, and red in the order I have mentioned, counting upward from the horizon. These sank one after the other, leaving at last an arc of brilliant red along the west, the inner portion of the segment contained by the arc being composed of orange. This disappeared in turn, and the whole western sky became yellow again without any distinct outlines, and this gradually deepened into red, which remained for an hour or more after sunset. The latter phenomenon was not unlike an ordinary sunset, except in brightness and duration.

But what could the refracting medium be? The air itself has refracting power, and so have the minute particles of moisture or ice which constitute the ordinary hazy clouds in the upper regions of the atmosphere; but it would be difficult to say why the effects which I have described should not be of more frequent occurrence if produced by either or both of these causes, since they are always present in a greater or less degree, and especially as there was apparently nothing unusual in the state of the weather at the time. Neither would clouds of smoke alone produce such effects as I have mentioned. In my native place in the United States, where vast tracts of prairie, and often of woodland, are burned over every autumn, a smoky haze is a common thing at that season of the year. Sometimes for days together the haze is so dense as almost to hide the sun, yet I never heard of any other effect upon the light than this obscuring of it, while the sunsets were especially dull and colourless. Nor do I see how these phenomena could be referred to unusual electrical conditions, for in that case they should be more common, as electrical storms are by no means unusual. I have been led, therefore, to wonder if the phenomena may not be the result of some fine transparent or semi-transparent dust particles in the upper regions of the atmosphere, which form the singular looking haze, and refract the light in the manner I have described, and whether the whole may not be traceable to the recent volcanic eruptions in Java.

According to the telegrams, the city of Batavia was darkened for thirty-six hours by clouds of dust from the volcano. True, we are a long distance from Java here, Ongole being in latitude 15° 30′ N., and longitude 80° 6′ E. But it is well known that the smoke and ashes from volcanoes are often carried to immense distances, and in this case, if acted upon by the trade winds, they would be carried away to the westward, and rising with the upward currents might enter the return trades, and so be swept over Southern India in a north easterly direction—the direction of our prevailing winds at this season of the year. However, I only venture this solution of the problem as a timid conjecture, the truth or falsity of which I have no means of demonstrating.

Will not some of the readers of NATURE who are better informed in regard to such matters kindly give me their opinions of the phenomena? I should be glad also to know if such effects upon the light as I have described have ever been noticed as the result of the smoke or dust or gases emitted by volcanoes.

Another thing which awakened about as much curiosity and speculation in the minds of the natives as the coloured light was the large spot now crossing the sun's disk. Ordinarily the atmosphere is so clear that even at sunset the sun cannot be viewed with the naked eye; but, being obscured as it was by the haze, the spot was distinctly visible to all.

Ongole, India, September 14 W. R. MANLEY

[Mr. Manley sends us several letters from the *Madras Mail* on the phenomenon; from these we give the following extract, dated September 10 :—]

A. T. M. writes :—"Unlike his usual custom the sun rose this morning clothed as it were in bright blue colour, rendering the whole horizon and all beneath it of the same hue. The pure, colourless river water looked as if it was just let out of an indigo vat. Even the green fields with grass and trees about looked blue. Our whitewashed house also had a temporary change of colour. This phenomenon lasted from 6 to 10 a.m."

The same phenomenon seems to have been observed in Trinidad on the afternoon of Sunday, September 2. Mr. J. Arnold, writing to the *Times*, gives the following extract from a correspondent's letter from Port of Spain :—

"We have been having very curious weather; last Sunday, about five o'clock, the sun looked like a blue globe, and with the aid of a small telescope I saw plainly three dark spots on it. After dark we thought there was a fire in the town from the bright redness of the heavens." Mr. Arnold adds: "All my correspondents agree as to the blue colour, and several seem to have noticed the spots. This occurrence, which was held to foretell bad weather, took place three days before the cyclone that swept Martinique."

THE JAVA ERUPTION

THE following details concerning this catastrophe have been sent by Lloyd's agents at Batavia, under date of Sept. 1 :—

"The past week is memorable as having witnessed one of the most disastrous and severe volcanic eruptions ever known in the Malay Archipelago. Krakatoa has again been the origin of the disturbance. On Sunday last, about 4 p.m., a series of detonations were heard proceeding apparently from the south-west Towards night these grew louder, till in the early morning the reports and concussions were simply deafening, not to say alarming. When day broke the atmosphere to the west had a sulphurous and lurid appearance, and a thin layer of fine white ash covered the ground. Towards 9 a.m. the reports died away, but about an hour later dark clouds quite obscured the sky and the sun. A heavy rain of ashes, sulphur, and dust commenced to fall, and at 11 a.m. this town was in pitch darkness and business totally suspended. About twelve o'clock (midday) a large wave about seventeen feet in height swept in from the sea, causing many prows and small craft to be driven ashore, but doing but little damage to the shipping in harbour. This being the dry monsoon, the rivers are low at present. The wave, however, drove an immense volume of water up our rivers, which suddenly rose so high that the banks at the river mouth were flooded and many small crafts stranded. Happily the wave subsided again suddenly, leaving the rivers almost dry, and about one o'clock the rain of ashes subsided and the atmosphere grew lighter. Shortly after 2 p.m., however, another wave, larger than the first, came rolling in from the sea. A few native fishermen were drowned by this wave, and two Europeans at Onrust also lost their lives. At Tandjong Priok the *Princess Wilhelmina* was within an ace of stranding, while some small crafts and prows were cast high up on land. No further damage, however, occurred in Batavia. The eruption, however, so far as we can learn, has had most fatal and disastrous effects all along the south-west coast of Java, and also on the south coast of Sumatra. We shall not probably be in possession of full particulars for some days yet, as telegraph lines are damaged and roads destroyed, but so far we can give the following particulars. The Island of Krakatoa, the summit of which peak was 2600 feet above water level, has totally disappeared below the sea, and the neighbouring Island of Dwaisindeweg is split in five parts. Sixteen new volcanic islands have been formed between Krakatoa and Sibesie, and the sea bottom in the Straits of Sunda has completely changed. In fact the Admiral Commanding-in-Chief has issued a circular stating that till new soundings have been taken the navigation of the Straits of Sunda is likely to be extremely dangerous. Anjer and lighthouse and the other lights of south-west Java have all been destroyed. The subsidences and upheavals we have alluded to caused a large wave about 100 feet in height to sweep down on the south-west coast of Java and south of Sumatra. This wave swept inland for a great distance, thereby doing great injury both to life and property. We are here only twelve miles away from one of the points on which the wave spent its fury. The whole coastline to the south-west has changed its configuration. The inhabitants of the Island of Onrust were only saved from the flood which swept over the island by taking refuge on board two steamers. At Merak Government establishment the inhabitants took refuge on the knoll, 50 feet high, but were all swept off and drowned, with the exception of one European and two Malays, who were saved. Mauk and Kramat, west side of Batavia Roads, have been laid waste, and about 300 lives lost. In Tjeringin only one house has been left standing. Both the native and European officials have perished. A rain of mud also fell at the above place, which is situated opposite to where Krakatoa Island once lay. Anjer seems to have been completely destroyed. Lloyd's subagent there wires from Serang: 'All gone. Plenty lives lost.' The dry dock at Amsterdam Island was carried away by the waves, but has since been found stranded in Middleberg Island. The Padang steamer, which left here on Sunday, returned next day to Anjer, only to find the place in ruins. The captain reports that his vessel was in great danger, owing to the eruption from Krakatoa. On his arrival at Telok Betong, his first port of call, the place was found completely destroyed. We understand that it has been submerged, but are not yet in possession of full particulars. We hear that on Monday the whole of West Java, as far as Banding, was shrouded in darkness and covered by ash rains. A telegram just in informs us that the explosions from Krakatoa were heard at Deli (Sumatra), which place is opposite Penang. The Government here, we understand, in the interest of shipping, are sending out steamers to cruise at either end of the Straits of Sunda, to warn vessels to observe caution while passing the Straits, as charts are no longer reliable. According to latest telegram from Serang we learn that in the residence of Tjeringin alone 10,000 lives were calculated to be lost. The Padang steamer just in reports that it is impossible to approach to the place where Telok Betong once was situated, owing to the sea being filled with pumice stone and mud. In some parts of Sumatra Straits the pumice stone is seven to eight feet deep."

THE BRITISH ASSOCIATION

SECTION C—GEOLOGY

On some Fossil Fish Remains found in the Upper Beds of the Yoredale Series at Leyburn, in Yorkshire, by James W. Davis, F.G.S.—The red limestone forms the upper part of the main limestone of Phillips, being separated from it by only one foot of shale or plate. It is about 100 feet below the millstone grits, the intermediate beds being composed of grits and shales with one bed of limestone about 16 or 18 feet thick. A peculiar aggregation of fish remains has been discovered in the red beds by Mr. Wm. Horne of Leyburn. They comprise nearly forty species, the majority of which are peculiar to the beds; others like *Cladodus* and *Petalodus* are common to the Mountain Limestone, and do not appear to differ either in size or otherwise from those of the lower massive limestone. The representatives of the genera *Psamodus*, *Cochliodus*, and *Polyrhizodus*, which are found abundantly in the lower limestone, and are of great size and importance, are in this locality comparatively small and rare, and appear to indicate that the fishes they represent were gradually becoming extinct. Their representatives are not known to occur in the superimposed Millstone Grits either in this locality or any other. There are in addition species of *Megalichthys* and *Pleurodus*, which are characteristic of the coal measures. The presence of so varied a fauna naturally leads to the inference that the circumstances under which they existed were not those usually characteristic of the aggregation of limestones, but rather indicate a shallow or shore deposit with occasional influxes of fresh water. *Megalichthys* and *Pleurodus* are fishes which in the coal measures probably lived in fresh or brackish water; and though they may have been adapted to exist in marine conditions, the occurrence of beds of sand and shale intercalated with the thin limestones of the Yoredales evidently shows the proximity of land, and it is probable that they were carried to their present position by rivers, and there deposited with the marine forms with which they are associated. The supposition that the water was brackish may account for the small size of some of the genera already mentioned and their final extinction in the grits and shales which succeed the limestone. The great fishes whose remains are found in the lower lime-